[Proc. Roy. Soc. Victoria, **45** (N.S.), Pt. I., 1933.]

Art. II.—*A New Genus of Fossil King Crabs.*

By ROBERT B. WITHERS, B.Sc., Dip.Ed.

(With Plate V.)

[Read 14th April, 1932; issued separately 28th February, 1933.]

A few months ago, F. Chapman (1) described the first two fossil King Crabs found in Australia, *Pincombella belmontensis*, from the Belmont beds of the Permian of New South Wales, and *Hemiaspis tunnecliffei* from the Silurian of Studley Park, Melbourne. The subject of the present paper is an addition to this interesting group from the Silurian beds of Kinglake West. The two specimens found are rather well preserved, and some of the characters are so peculiar as to call for generic distinction.

Description.

Phylum ARTHROPODA.

Class ARACHNIDA.

Sub-class MEROSTOMATA Dana (emend. Woodward).

Order SYNXIPHOSURA Packard.

Sub-order BUNODOMORPHA J. M. Clarke.

Family HEMIASPIDAE Zittel.

Genus **Rutroclypeus**, gen. nov.

Diagnosis.—Cephalothorax circular or subcircular, and entirely unlobed. Genal spines not observed. Abdomen small and narrow, width half or less than half that of the cephalothorax. Number of abdominal segments twelve, the first nine free, the last three closely conjoined. Telson relatively long and fused with the last segment of the abdomen.

Genotype.—*Rutroclypeus junori*, sp. nov.

Observations.—The genotype is founded on two specimens, the mould of the dorsal side of a practically complete animal (holotype), and the other of the abdominal region only (paratype). A small portion of the anterior part of the dorsal shield is missing, but there is no doubt that the shape is circular. (Pl. V.)

The first two anterior segments of the abdomen are not well shown, but are made clearer on a wax squeeze. They appear to lie within the bounds of the dorsal shield, but this is probably due to the extension of the latter by flattening of the thin tumid carapace in the matrix. The last (posterior) segment is fused with the telson, but following the practice of workers on this group, it has been counted as an abdominal segment, not as a part of the telson. The name is derived from *rutrum*—a shovel, and *clypeus*—a shield, a reference to the function as well as the shape of the well-developed dorsal shield.

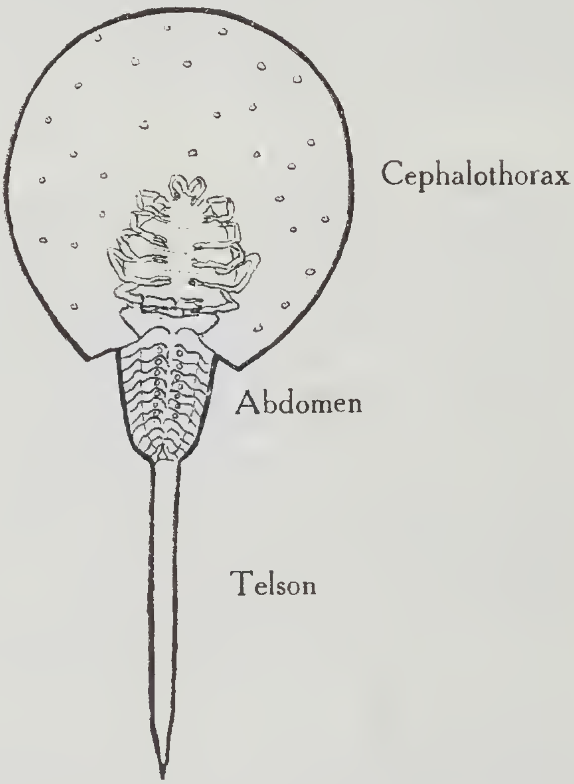
Relationships.—*Rutroclypeus* is placed in the rather heterogeneous family, *Hemiaspidae*. The reasons for so doing are the rounded, relatively large cephalothorax, and the number of abdominal segments. It has the greatest number (twelve) of abdominal segments of any King Crab—*Bunodes*, with ten segments, being, as far as I am aware, the nearest in this respect. The very large prosoma of the genus suggests the Hemiaspid *Pseudoniscus* from the Silurian of the Island of Oesel, and New York State; but *Pseudoniscus* has a relatively wider abdomen, and its prosoma is semicircular. The same feature suggests comparison with *Bunodes*, another Silurian genus from Oesel, but in this case the prosoma is strongly furrowed and the abdomen divided into a wide mesosoma and a narrow metasoma. *Bunodes*, like *Rutroclypeus*, has a very long telson.

Rutroclypeus junori, sp. nov.

Description.—The cephalothorax is large and circular, and has a characteristic tessellated appearance. The surface of the impression shows a number of regularly disposed dimples, corresponding to a spinose condition on the carapace. These depressions, where present, are in the centres of the tesselae. A line of such depressions, somewhat closer than elsewhere, follows the rim of the cephalothorax. The surface is also minutely granulated. From the specimen, the degree of convexity of the cephalothorax is difficult to estimate. No genal spines were observed. Abdomen small and narrow, at its proximal end slightly less than half the width of the cephalothorax. Number of somites 12, the last three closely conjoined. Axis at proximal end about half width of abdomen, thence tapering rather sharply towards telson. Centre of axis marked by a deep furrow, to either side of which is a line of prominent tubercles, one to each somite. The bounding axial furrows are not strongly marked. The telson is fused with the last axial somite, and thence extends for a length at least equal to that of the cephalothorax, and probably more, as portion of the end may be missing.

Dimensions.—Holotype (13681, National Museum, Melbourne). (Plate V. fig. 1.) Transverse diameter of restored cephalothorax at widest part, 5·1 cm. Longitudinal diameter of restored cephalothorax 5·1 cm. Length of abdomen 2·0 cm.; width of abdomen at proximal end 1·4 cm. Width of axis at proximal end 0·6 cm. Length of telson (portion of distal end probably missing), 4·0 cm. Paratype (13682, National Museum, Melbourne), (Pl. V, fig. 2). Length of abdomen, 2·3 cm.; width of abdomen at proximal end 1·2 cm.; width of axis at proximal end, 0·6 cm.

Relationships.—Certain species of *Hemiaspis* described by H. Woodward from the Lower Ludlow beds of Great Britain are the most closely related forms, and may belong to the genus *Rutroclypeus*. Both, however, are known only from their dorsal shields. *H. speratus* H. Woodward [(7), p. 178, pl. xxx, figs. 5 and 7], has a transversely orbicular cephalothorax, but lacks all ornament except a fine granulation, and is smaller. *H. salweyi* Salter (*ibid.*, p. 179, pl. xxx, fig. 4) is close to the present species in shape and breadth of the cephalothorax, though rather more transverse, and distinctly tumid. It also has a minute granular ornamentation of the carapace, and rounded tubercles, which are, however, restricted to the central area. Further, *H. salweyi* has spines along the posterior border of the dorsal shield.



Suggested Outline of *Rutroclypeus junori* from Holotype (No. 13681). Dorsal view. About natural size. (Position of limbs suggested under shield).

Occurrence.—The type specimen was found by Mr. P. Junor of Kinglake West, a keen collector, who has presented a fine collection of fossils from this district to the National Museum, and I have much pleasure in naming the species after him. The paratype was found by the author. The form occurs in Collins' Quarry, about 1½ miles north-west of the Kinglake West Post Office, the matrix being a medium grained micaceous sandstone of greenish colour. Associated with *Rutroclypeus* is a typical shallow-water fauna, from which the following forms have been identified:—

Anthozoa.	*Pleurodictyum megastomum* Chapman.
	Pleurodictyum sp. nov.
	Numerous indeterminate corals.
Graptolitoidea.	*Climacograptus* (?) cf. *extremus* Lapworth.
Crinoidea.	Numerous indeterminate forms
Asteroidea.	*Sturtzura leptosomoides* Chapman.
	Protaster brisingoides Gregory.
	Palaeaster sp. nov.
Brachiopoda.	*Rhynchotrema liopleura* McCoy.
	Chonetes bipartita Chapman.
	Numerous indeterminate forms.

Observations on the Dorsal Shield of Rutroclypeus.

The dorsal shield of *Rutroclypeus* bears a strong resemblance both in size and rigidity to the cephalic shield of some of the more primitive trilobites, among which may be mentoned the *Trinucleidae, Harpedidae, Neolenus, Bathyurus,* and *Isotelus.* In its size relative to the rest of the body the dorsal shield is unusually large, while its rigidity is indicated by the absence of facial sutures. The derivation of King Crabs from trilobites has been suggested by Woodward [(8), p. lxxxiii], Packard (3) and others, but the modern view is that the limuloids are marine arachnids rather than archaic crustaceans. This view, first suggested by Strauss-Durkheim in 1829, has been elaborated by Van Beneden, Kingsley and Laurie, and, particularly, by the researches of Lankester (2). This conception has general and increasing support. The branchial respiration common to limuloids and trilobites, on which relationships were formerly based, must be regarded as a purely adaptive feature due to the aquatic life of both classes, and therefore of no critical classificatory value. Doubtless the triangular shape of the body with its long slender tail-spine, common to many King Crabs and trilobites, is also an adaptive character. On the other hand, in living forms, the numerical and structural homologies in the appendages of limuloids and arachnids, as well as a close parallelism in their central nervous system, are of considerable taxonomic importance. In identifying *Rutroclypeus* as a King Crab, reliance has necessarily to be placed on more superficial characters, nevertheless these considerations exclude the possibility of its having a trilobitic ancestry. The parallelism in shape and size of the dorsal shield and the body generally is undoubtedly due to similar modes of life. It is well known that the modern *Limulus* feeds by burrowing in the mud. The habits of life have been investigated by Lockwood [(4), p. 265]. He describes *Limulus* as scooping or gouging its way through the mud with great facility. The shield is pressed downward and forward, the sharp point of the tail giving the necessary purchase, while underneath the shield the animal is incessantly scratching up and pushing out the earth on both sides. There is little doubt that the trilobites we have referred to had similar habits. Specimens of Trinucleus have been found containing stone casts in the stomach and intestine (5), suggesting that the animal gorged itself with mud and abstracted the nutriment as does the earthworm. Walcott's researches on Cambrian trilobites (6) have shown that some trilobites lived on soft bodied animals and fine delicate algae, for which "they worked down into the mud like *Limulus*" (*loc. cit.*, p. 124). He observes that the large head shield present in these trilobites is to be correlated with this habit of life, and I have little doubt that the large head shield of *Rutroclypeus* functioned in the same way. In short, the size and shape of the shields in both cases are adaptive characters suited to their similar modes of life. Likewise the long tail spine is an adaptive character, the development of which is regulated by that of the dorsal shield. The larger the shield the greater would be the pushing purchase required from the tail spine in the process of burrowing.

Acknowledgment.—In conclusion I should like to thank Mr. R. A. Keble of the National Museum for much valuable criticism of the paper, and for assistance with the illustrations, which are almost entirely due to him.

Bibliography.

1. CHAPMAN, F., 1932. Two new Australian Fossil King Crabs, *Proc. Roy. Soc. Vic.* (n.s.), xliv, (1), pp. 100-102, pl. xiv, figs. 1-5.
2. LANKESTER, E. R., 1881. Limulus an Arachnid. *Quart. Journ. Microsc. Sci.*, xxi, pp. 504.548, 609-649.
3. PACKARD, A. S., 1885. On Carboniferous Xiphosurous Fauna of N. America. *Mem. Nat. Acad. Sci.*, iii, pp. 143-157, pl. v-vii.
4. SHIPLEY, A. E., 1909. Introduction to Arachnida and Xiphosura. *Camb. Nat. Hist.*, vol. 4, pp. 255-279.
5. SWINNERTON, H., 1923. Outlines of Palaeontology, p. 251.
6. WALCOTT, C. D., 1924. Appendages of Trilobites. Cambrian Geol. and Pal., Pt. IV. *Smith, Misc. Coll.*, lxvii, No. 4, pp. 115-217, pl. 14-42.
7. WOODWARD, H., 1872. Fossil Merostomata Pt. IV. *Mem. Pal. Soc.*, xxvi, pp. 121-180, pl. xxi-xxx.
8. ———, 1895. Life History of Crustacea in Early Pal. Times, *Pres. Add. to Geol. Soc., Quart. Journ. Geol. Soc.*, l., pp. lxx-lxxxviii.

Explanation of Plate V.

Fig. 1.—Rutroclypeus junori, gen. et sp. nov. Mould of dorsal side (×1¼ diam.). Holotype. No. 13681, Nat. Mus., Melb.

Fig. 2. Rutroclypeus junori. Mould of abdomen, dorsal side (×2 diam.). Paratype. No. 13682, Nat. Mus., Melb.